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by Murray L. Hayes and Donald T. Montgomery

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MOVEMENTS OF KING CRABS TAGGED AND RELEASED IN SHUMAGIN ISLANDS AREA, 1957-62

by

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ABSTRACT

During the summer of 1957, 1,999 male king crabs *(Paralithodes camtschatica)* were tagged and released in the Shumagin Islands-False Pass area south of the Alaska Peninsula. By August 15, 1962, 13.8 percent of the number released had been returned.

Tagged crabs from single offshore release locations were usually caught in more than one bay, suggesting that the summer stock offshore was made up of components found in separate locations at other times of the year. Tagged crabs released inside or near the mouths of bays were usually returned from the same general area, suggesting little movement between bays. Minimum distances of individual crab movements between tagging and recovery varied from 0 to 110 miles, but more than 90 percent of the returns were taken less than 35 miles from the tagging site.

No recoveries were made by the U.S. or Japanese fishery in the Bering Sea.

Growth of the crabs was similar to that previously reported. Biennial and triennial molt periods were indicated for large crabs.

INTRODUCTION

This paper reports migration and growth data from recoveries of king crabs *(Paralithodes camtschatica)* tagged during 1957 in the Shumagin Islands-False Pass area south of the Alaska Peninsula. The original purpose of the tagging study was to determine if king crabs moved from the area south of the Alaska Peninsula into the Bering Sea. Biologists from the Bureau of Commercial Fisheries Biological Laboratory in Seattle tagged the crabs in conjunction with an exploratory fishing cruise made to search for commercial stocks of king crab, shrimp, and bottomfish in the same area. Johnson (1959) has reported the exploratory phase of the work.

Alaskan fishermen have harvested king crabs commercially since at least 1909, but catches were sporadic and small until after World War II. In 1940, the Federal Government began a 2-year technical, economic, and biological investigation of the king crab resource off the coast of Alaska. This study revealed a crab population in the Shumagin Islands area

large enough to support a profitable commercial operation (U.S. Fish and Wildlife Service, 1942). War conditions, however, made any serious expansion of the fishery difficult at that time.

After the war, interest in the king crab fishery increased, but technological and marketing problems kept production low until about 1950. Many of these problems have been solved, with the result that the king crab catch in Alaska waters increased from 1.5 million pounds in 1950 to almost 44 million pounds in 1961.

The U.S. commercial fishery during the late 1940's and early 1950's concentrated in the Bering Sea in locations proved productive by Japanese factory ships before World War II. Concurrently, commercial stocks were being developed in the Cook Inlet, Kodiak, and Alaska Peninsula areas. In 1953, U.S. production in these new areas south of the Alaska Peninsula exceeded that in the Bering Sea, and since that year, efforts have been concentrated on stocks south of the peninsula. Figure 1 shows the U.S. catch of king crabs in each of the major production areas.

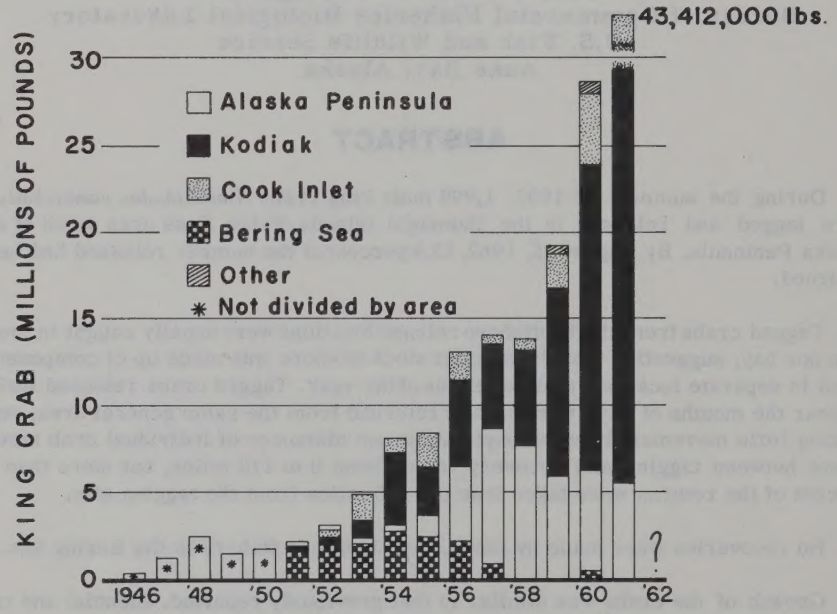

Figure 1.--King crab catch by major production areas, Alaska, 1946-61.

The U.S. Government submitted a request for study of the southeastern Bering Sea king crab stock to the International North Pacific Fisheries Commission in February 1954. The problem to be studied was defined as ". . . determining the need for joint conservation measures . . . of that stock." One phase of the investigation was to determine if the crab populations in the Bering Sea were discrete from the populations south of the Alaska Peninsula. The tagging study reported here was designed to answer this question in part.

Crabs for tagging were captured in crab pots, Gulf of Mexico-type shrimp trawls, and large-mesh otter trawls that were fished from the chartered vessel *Tordenskjold* between July 21 and October 1, 1957. Crabs smaller than 100 mm. and females were not tagged because they could not reasonably be expected to be recovered by the selective male-only fishery. Male king crabs were tagged with loop tags, which were threaded through the isthmus, and were immediately released at the sites of capture. Tagging methods have been described by E. J. Huizer (*in* Alaska

Fisheries Board and Alaska Department of Fisheries, 1955: p. 34-43) and Hayes (in press).

The tags were recovered from the commercial fishery. In some instances processors held the whole tagged crab in their freezers until a biologist could take the necessary measurements, but more often only the tag was returned--usually by mail.

Before discussing results, two major sources of bias should be recognized: the nature of the fishery in the area and the lack of personal contact by biologists with fishermen during the tag return phase of the study.

In general the fishery for king crabs in the Shumagin Islands-False Pass area has been pursued by salmon fishermen during the fall, winter, and spring. Intensity and timing of the crab fishery depend on economic conditions and especially on the income received from salmon in the preceding season. Although most boats are small and fish in protected waters close inshore, in some years larger trawlers have fished areas offshore for short periods.

To obtain complete and reliable information from tagging studies requires extensive personal contact with fishermen. Funds were not available for this purpose during the tag return phase of this study, and many of the returns are incomplete.

MOVEMENTS

Of the 1,999 male king crabs tagged, 1,517 were caught in pots, 284 in shrimp trawls, and 198 in large-mesh otter trawls. Data are not sufficient to determine if gear influenced the rate of return of tagged king crabs. Through August 15, 1962, tags from 277 (13.8 percent of those released) crabs were returned, including 232 with the location of recovery and 65 with measurement data.[1] Table 1 lists the number of tags returned each year. April 1 was chosen as the beginning of the year because this date is considered to approximate the time of molt (beginning of growth year).

Table 1.--Number of tags returned between Sept. 1, 1959, and Aug. 15, 1962, from crabs tagged near Shumagin Islands in 1957

Time period	Molt anniversaries after tagging	Tags returned
	Number	*Number*
Sept. 1, 1957[1/]-March 31, 1958	0	72
April 1, 1958-March 31, 1959	1	87
April 1, 1959-March 31, 1960	2	33
April 1, 1960-March 31, 1961	3	5
April 1, 1961-March 31, 1962	4	9
April 1, 1962-Aug. 15, 1962	5	1
Unknown		70

[1/] September 1 date is arbitrary, since the crabs were tagged between July 21 and October 1, 1957.

The location of tagging and recovery sites or tags returned from south of the peninsula are presented diagrammatically in figure 2. The distance between the locations of the easternmost and westernmost tag returns is about 150 miles.

No recoveries were made from the U.S. or the Japanese fishery in the Bering Sea.

[1] Three additional tags were returned between August 15, 1962, and February 1, 1963. The tags had been retained by the crabs for more than 6 years through 5 molt seasons. Movements were similar to those reported in this paper. Growth measurements were not obtained.

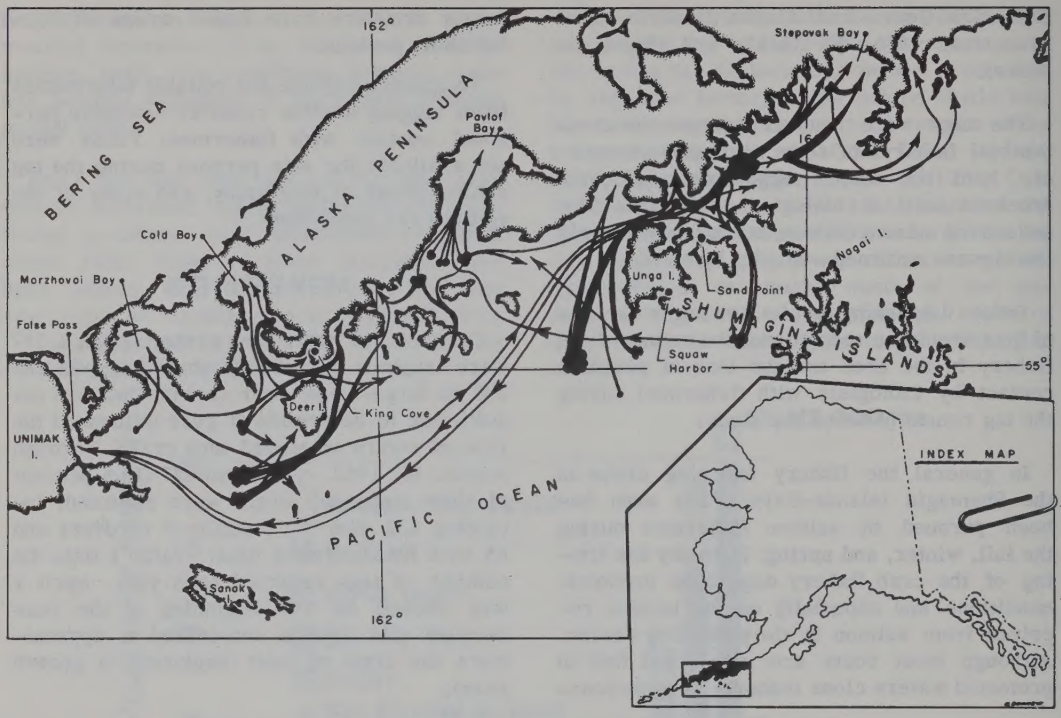

Figure 2.--Diagrammatic migrations of tagged kings crabs, 1957-62 (232 returns).

Migrations demonstrated by location of release and recapture of tagged crabs show that crabs released offshore in late summer generally migrated shoreward. Returns from single offshore release locations were often caught in more than one bay, indicating that the summer stock offshore was made of components found in separate locations at other times of the year. Tagged crabs released inside of or near the mouths of bays were usually returned from the same general area, indicating little movement between bays. Minimum distances of individual crab migrations varied from 0 to about 110 miles, but more than 90 percent of the returns indicated migrations of less than 35 miles (table 2). Since crabs were tagged offshore during the summer and recoveries were made inshore at other times of the year, the migrations may be maximal for these stocks.

Extreme migrations in this study include two crabs taken by trawl in False Pass on the same day in April 1958. The crabs were released north of Unga Island, traveled about 110 miles southwest, and were at liberty for about 200 days. A crab captured in Balboa Bay in the fall of 1958 showed a migration in the opposite direction of similar magnitude. It was released north of Sanak Island, traveled about 110 miles northeast, and was at liberty just over 1 year.

The depths in which tagged crabs were recaptured also indicate seasonal inshore-offshore movement, since crabs were captured in deeper waters during the summer and fall (table 3).

Table 2. --Minimum distance crabs traveled between tagging and recovery

Distance traveled	Tagged crabs recovered	
Nautical miles	*Number*	*Percent*
0- 5	72	31.0
6- 10	25	10.8
11- 15	31	13.4
16- 20	21	9.1
21- 25	23	9.9
26- 30	32	13.8
31- 35	10	4.3
36- 40	7	3.0
41- 45	1	0.4
46- 50	3	1.3
51-110	7	3.0
Total	232	100.0

Table 3. --Average depth by month of tagged king crabs recaptured in the Shumagin Islands area, Alaska, 1957-62

Month	Recaptures with depth information	Average depth
	Number	*Fathoms*
April	10	31
May	0	
June	0	
July	0	
August	1	65
September	13	71
October	23	83
November	0	
December	8	18
January	6	25
February	3	33
March	16	22

GROWTH

King crabs, because of their rigid exoskeletons, are able to increase in size only immediately after molting and before their new shells become hardened. Growth is therefore determined by increment per molt and molt frequency information. Three intensive growth studies on the Alaskan king crab have been made: at Kodiak (Powell, 1960); in Cook Inlet (Bright, Durham, and Knudsen, 1960); and in the Bering Sea (Weber and Miyahara, 1961). Males and females grow at a similar rate until sexual maturity. In the first years of life, several molts occur per year. Molt frequency decreases as size increases, however, and is annual when sexual maturity is reached. Up till this time, growth increment

is 20 to 25 percent of body length per molt. Adult male crabs grow from 16 to 22 mm. in length per molt, but molt frequency decreases to biennial at about 145 to 165 mm. in carapace length and may be triennial in large adults. Males reach sexual maturity in 4 to 6 years, are recruited to the fishery (minimum legal length about 140 mm.) at about 6 to 8 years, and may reach maximum size in about 11 to 13 years. Under the present size restrictions, males are sexually mature 2 years before recruitment to the fishery.

Since carapace measurements are available for only 65 returns, growth data from this tagging study are limited. The data available are plotted in figure 3. They suggest growth rates similar to those found for king crabs in other locations south of the Alaska Peninsula and in the Bering Sea. The small positive bias in returns showing no growth is due to measurement errors up to $\pm$ 4 mm. and the fact that minus measurement errors were recorded as 0. This bias should not be present in returns showing growth. No detailed analysis of growth increment per molt has been made because of the limited data. There are, however, some interesting observations to be made from these data, since some crabs remained free for as long as 5 years.

The cluster of points for crabs that show no growth (near 0 on ordinate of figure 3) indicates no observations for crabs at liberty for more than two molt seasons. (Adult king crabs molt in the winter or early spring, and April 1 has been selected for purposes of analysis as the molt anniversary.) This is evidence that most crabs molt at least biennially.

Most crabs in the cluster showing one molt (near 17 mm. on the ordinate of figure 3) were at liberty for one or two molt seasons. Two crabs in this group were recovered after three molt seasons. One of these was 143 mm. in carapace length at the time of release and should have molted twice. The second was 178 mm. in carapace length and may represent a biennial molter. Another crab in this group was recovered after four molt seasons. It was 174 mm. in carapace length when released. The fact that this crab had an old shell when released (skipped previous molt)

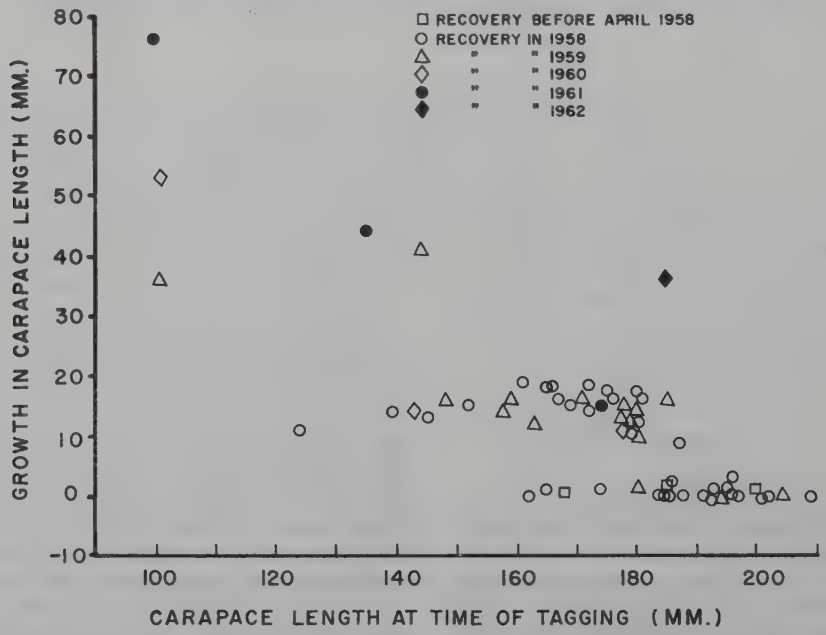

Figure 3.--Growth increment between release and recovery, king crab tagging. Shumagin Islands area, 1957-62. (Growth year considered to extend from April 1 to March 31.)

and was at liberty for four molt seasons indicates at least one triennial molt period.

Other returns indicate rapid growth among smaller crabs--witness the 2-, 3-, and 4-year returns near 100 mm.; the 1-year return at 124 mm.; and the 4-year return at 135 mm. A crab that was 185 mm. in carapace length when released was recovered after five molt seasons and grew 36 mm. Its measurements at the time of recapture were 221 mm. carapace length and 265 mm. carapace width. To our knowledge this crab was equal in width and was only 3 mm. less in length than the largest king crab ever measured by biologists in Alaska.

SUMMARY

1. In July and August 1957, 1,999 male king crabs were tagged in the Shumagin Islands-False Pass area south of the Alaska Peninsula.

2. Through August 15, 1962, 277 tags were returned.

3. No recoveries were made in the Bering Sea.

4. Local movements south of the Peninsula were principally from offshore tagging locations to inshore fishing locations in protected waters.

5. More than 90 percent of the returns showed migrations of less than 35 miles. Maximum migrations were about 110 miles.

6. Growth for commercial-sized males was near 17 mm. per molt. Biennial and triennial molt periods were indicated for large crabs.

ACKNOWLEDGMENTS

The staff of the King Crab Investigations, Bureau of Commercial Fisheries Biological Laboratory, Seattle, Wash., performed the original tagging work for this study. Personnel of the Alaska Department of Fish and Game collected many of the tag returns, and for this effort, thanks are due especially to Guy C. Powell and Glen Davenport.

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